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WINDSHIELD PLATE
[Fuboban]

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(57) [Abstract]

[Purpose]

To easily and economically provide a windshield plate made of a polycarbonate resin having excellent transparency and impact strength suitable for a helmet shield, the windshield of a motorcycle, the window material of an airplane or a car, or the like which also has durable anti-fog and anti-weather properties.

[Constitution]

A windshield plate wherein a thermal plastic resin film having anti-fog properties is thermally crimped on one side of a polycarbonate resin plate and a thermal plastic resin film is thermally crimped on other side thereof, which has anti-fog properties of 3% or less and impact strength of 60kgf·cm/cm or more.

[Claim] /*

[Claim 1] A windshield plate wherein a thermal plastic resin film having anti-fog properties is thermally crimped on one side of a polycarbonate resin plate and a thermal plastic resin film is thermally crimped on the other side thereof, which has anti-fog properties of 3% or less and impact strength of 60kgf·cm/cm or more.

[Detailed Description of the Invention]

[0001] [Field of Industrial Application]

The present invention relates to a polycarbonate resin plate. More specifically, it relates to the windshield made of a polycarbonate resin having excellent transparency and impact strength as well as durable anti-fog and anti-weather properties.

[0002] [Prior Art]

A polycarbonate resin plate is used for an extensive application because of the excellent transparency and impact strength thereof; however, it has disadvantages in anti-fog properties and anti-weather properties. Because of this, the application thereof was limited since excellent transparency and impact strength as well as excellent anti-fog properties and anti-weather properties were required for application as a helmet shield, windshield of a motorcycle, window material of an airplane or a car, or the like.

[0003] Generally, a paint having anti-fog performance is applied on one side of the polycarbonate resin plate and a paint having the anti-weather performance is applied on the other side thereof so as to

* Claim and paragraph numbers correspond to those in the foreign text.

improve the anti-fog properties or anti-weather properties of the polycarbonate resin plate. However, applying the paint having anti-fog performance on one side of the polycarbonate resin plate and the paint having anti-weather performance on the other side thereof involves painting on each side with paints of different quality, hence the painting process becomes complicated and good appearance is hard to obtain. Furthermore, a problem may occur in that the coating film performance may not be fully exhibited due to the different painting, drying, and baking conditions of the two paints.

[0004] There is a technique for kneading an anti-fog agent or anti-weather agent into the polycarbonate resin plate, however, the anti-fog agent or anti-weather agent needs to be added in a large amount. Because of this, the appearance or performance thereof may be impaired due to the lowered transparency or bleeding caused by additives.

[0005] Furthermore, there is another technique for bonding a film having anti-fog performance on the other side with adhesives. However, if this technique is applied to the polycarbonate resin plate, the polycarbonate resin plate becomes white or the impact strength is lowered due to the effects of the adhesives. In addition, there are very few adhesives that keep the adhesion for a long period of time.

[0006] [Problems to Be Solved]

The purpose of the present invention is to easily and economically provide a windshield plate made of a polycarbonate resin having excellent transparency and impact strength suitable for a helmet shield, the windshield of a motorcycle, the window material of an airplane or a car,

or the like, which also has durable anti-fog and anti-weather properties.

[0007] The inventors were dedicated to achieving the above purpose. As a result, they found that if a thermal plastic resin film having anti-fog properties and a thermal plastic resin film having anti-weather properties are thermally crimped on each side of the polycarbonate resin plate, the polycarbonate resin plate having durable anti-fog properties and anti-weather properties can be obtained without lowering the excellent transparency and impact strength of the polycarbonate resin plate, thereby implementing the present invention.

[0008] [Means for Solving the Problem]

The present invention relates to a windshield plate wherein the thermal plastic resin film having anti-fog properties is thermally crimped on one side of the polycarbonate resin plate and the thermal plastic resin film having anti-weather properties is thermally crimped on the other side thereof, which has anti-fog properties of 3% or less and impact strength of 60kgf·cm/cm or more.

[0009] The windshield plate of the present invention refers to the plate used as a helmet shield, the windshield of a motorcycle, the window material of an airplane or a car, or the like.

[0010] Figure 1 is a perspective view of the windshield of the polycarbonate resin of the present invention, wherein 1 is a polycarbonate resin substrate, 2 an anti-fog film, and 3 an anti-weather film.

[0011] The polycarbonate resin used by the present invention is obtained by making a dihydric phenol and a carbonate precursor react by a solution technique or a fusion technique. Although

2,2-bis(4-hydroxyphenyl)propane [common name bisphenol A] is intended as the dihydric phenol, a part or all thereof may be replaced by other dihydric phenols. As other dihydric phenols, for example 1,1-bis(4-hydroxyphenyl)ethane, 1,1-bis(4-hydroxyphenyl)cyclohexane, 2,2-bis(4-hydroxy-3,5-dimethylphenyl)propane, 2,2-bis(4-hydroxy-3-methylphenyl)propane, bis(4-hydroxyphenyl)sulfide, bis(4-hydroxyphenyl)sulfone, and the like are available. As the carbonate precursor, for example, phosgene, diphenyl carbonate, bis chloroformate of the above-mentioned dihydric phenols, di-p-tolyl carbonate, phenyl-p-tolyl carbonate, di-p-chlorophenyl carbonate, dinaphthyl carbonate, and the like are available, among which phosgene and diphenyl carbonate are especially preferred. The degree of the polymerization of the polycarbonate resin is expressed with a viscosity average molecular weight, which is normally 15 , 000 - 40 , 000, preferably 18 , 000 - 30 , 000. Although any thickness of the polycarbonate resin plate can be selected, normally it is approximately 1 - 10mm.

[0012] To produce such polycarbonate resin, it is possible to add a suitable molecular weight modifier, a branching agent for improving the processability, a catalyst for promoting the reaction, a colorant, and 0 . 001 - 0 . 1 weight % of a stabilizer such as phosphorous acid ester, phosphoric acid ester, phosphorous acid ester, or the like; 1 - 20 mol % of a flame retardant such as tetra bromine bisphenol A, low molecular weight polycarbonate of tetra bromine bisphenol A, decabromodiphenyl ether

or the like.

[0013] The anti-fog film used for the present invention is a film of thermoplastic resin having anti-fog properties. For example, a lamination film of at least one type of film selected from a group of cellulose ester compounds such as polyvinyl alcohol, polyacrylamide and acetyl cellulose, diacetyl cellulose, triacetyl cellulose, acetyl propyl cellulose, acetyl butyl cellulose, or the like; or partially saponifiable substances of these cellulose ester compounds and an acrylic resin film wherein a thermal or a UV curing type anti-fog paint or the like was applied, and the like are available. The thickness of such anti-fog film is normally approximately 10 - 100μ.

[0014] The anti-weather film is a thermoplastic resin film wherein the anti-weather agent is blended, and an acrylic resin film, an acrylic resin film laminated fluoro resin film, and the like which contains 0.1 - 10 weight % of an ultraviolet ray absorbent are available, for example. The thickness of such anti-weather film is normally approximately 10 - 100μ.

[0015] With regard to the technique for laminating the anti-fog film and anti-weather film on each side of the polycarbonate resin plate, any technique can be employed as long as it involves thermal crimping. For example, a thermal crimping technique used for a laminating machine, a press machine, or the like; a technique for thermally crimping to the polycarbonate resin plate which is in a state of fusion immediately after extrusion, and the like are available. Especially, the thermal crimping

technique performed immediately after extrusion is preferable. Since the thermal crimping condition varies depending on the properties of the polycarbonate resin plate, anti-fog film, and the anti-weather film, it cannot be categorized. However, the thermal crimping can be normally performed 0.03kg/cm^2 or more at the vicinity of, or higher than, the secondary transition temperature of the above film, and preferably under approximately 0.05 - 5kg/cm^2 pressure.

[0016] [Embodiments of the Invention]

The present invention will be further explained by using the embodiment below. The evaluation method of the property values are as follows.

[0017] Impact strength: based on Izod impact strength ASTM D-790 (with a notch). A 3mm thick specimen (kgf·cm/cm) was used.

[0018] Degree of fogginess: measured based on JIS K-6735 (Hayes %), by an integrating sphere type light transmission measuring device H.T. R. Meter (C light source) (Nippon Precision Instruments, Inc.).

[0019] Adhesiveness: measured by a cross-cut adhesion test based on JIS K-5400, wherein 0/100 demonstrated the occurrence of all exfoliation, and 100/100 demonstrated the occurrence of no exfoliation.

[0020] [Embodiment 1 and Reference Example]

A fusion of the polycarbonate resin having the average viscosity molecular weight of 24,300 obtained from bisphenol A and phosgene was extruded on a plate of 3mm thick and 1,000mm wide by an extrusion machine having a T die of 90mm screw diameter. While the surface temperature thereof

was 140°C, it was held by a pair of rolls of 300mm diameter, wherein a pressure was applied to 0.5kg/cm^2. An anti-fog film of diacetyl cellulose wherein a 50μ thick, 1,000mm wide acrylic copolymer was laminated was inserted into one side of the plate, and an anti-weather film of 50μ thick, 1,000mm wide acrylic copolymer was inserted into the other side of the plate respectively so that they were thermally crimped. To thermally crimp the anti-fog film, the acrylic polymer laminated side was adhered to the surface of the polycarbonate substrate.

[0021] The laminated plate obtained was transparent and had no unusual appearance such as wrinkles or the like. The impact strength and degree of fogginess thereof was shown in Table 1.

[0022] For reference, the impact strength and degree of fogginess of a 3mm thick polycarbonate resin plate which was produced with no anti-fog film nor anti-weather film inserted is shown in Table 1.

[0023] [Table 1]

	Impact Strength (kgf·cm/cm)	Degree of Fogginess (Hayes %)	Adhesiveness	
			Anti-fog Side	Anti-weather Side
Embodiment 1	93	0.3	100/100	100/100
Reference Example	95	0.2	---	---

[0024] [Effects of the Invention]

According to the present invention, it is possible to provide a polycarbonate resin windshield plate having excellent transparency and impact strength, as well as durable anti-fog and anti-weather properties, quite easily and economically, which has a significant effect.

[Brief Explanation of the Figure]

[Figure 1] A perspective view of the polycarbonate resin windshield

plate of the present invention.

[Explanation of the Reference Numerals]

1 Polycarbonate resin substrate

2 Anti-fog film

3 Anti-weather film

[Figure 1]